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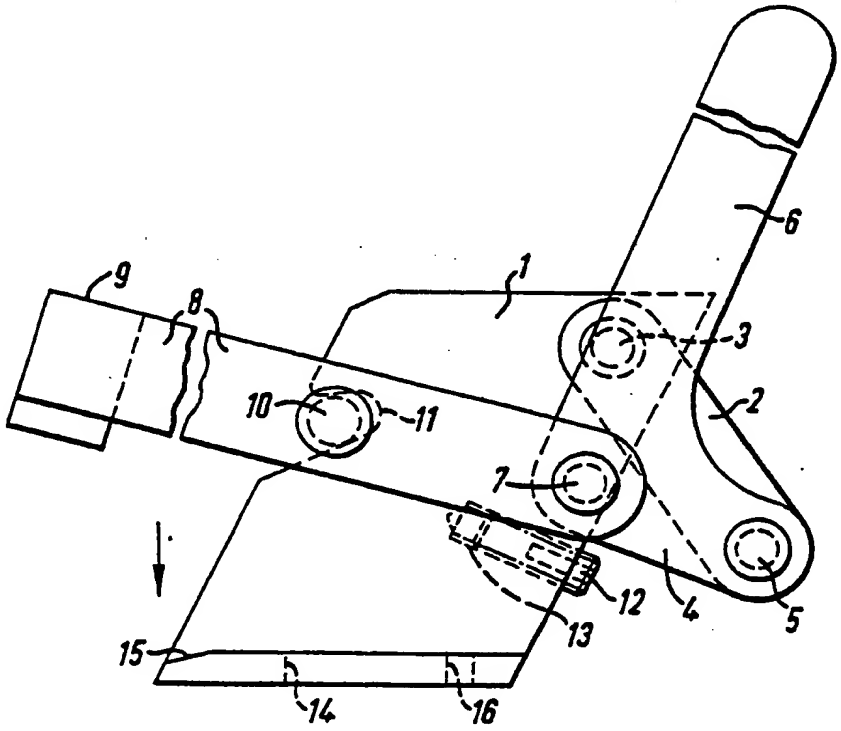
(54) Title: TOGGLE OPERATED CLAMP


(57) Abstract

Juxtaposed-links differential toggle linkages as used hitherto on industrial clamps usually apply toggle pressure to a straight clamp bar sharing pressure between a fixed fulcrum pin and the clamping end of said bar, or else use a cranked clamp bar with arm lengths fixed by overall height of clamp, and having the short toggle link and handle pivotally fixed to clamp body. This invention concerns a toggle clamp having a juxtaposed-links differential toggle linkage to actuate near end of adjacent clamping bar (8), said bar (8) having a fulcrum element (10) intermediate said linkage and the remote clamping end (9) of said bar with, on manually operated clamps, the optional use of quick release/retention slots (11) for fulcrum element (10) and clamp bar, plus slot/s (14) in clamp base for rapid set-up/removal of clamp.

# DESCRIPTION

## TOGGLE OPERATED CLAMP

This invention relates to clamps and in particular to clamps operated via toggle linkages.

Industrial clamps usually comprise a clamping bar having a clamping head at one end which is used to bear down upon a work piece to securely hold it in position. The other end of the clamp bar is usually pivoted about a fulcrum pin and a downward force is applied between the fulcrum pin and the clamping head to pivot the clamping bar down into its clamped position. Toggle mechanisms are frequently used to effect

this motion, but since the toggle pressure is applied downwardly between the fulcrum of the clamp bar and its operating head there is inevitably wastage of the applied pressure on the fulcrum pin. If the fulcrum pin is placed intermediate the toggle mechanism and the clamping head the downward clamping force at the head requires a toggle mechanism that provides an upward acting force. This requirement has limited the use of intermediate fulcrum pins mainly to clamps using an opposed-links toggle; so if a differential-links toggle clamp is required this has usually entailed using a bell-cranked clamping bar with its limited leverage for a given height and utility.

Existing toggle clamps often have the additional drawback that the clamp handle or the clamp bar, or both, obstructs the free passage of cutting tools or hinders the loading of components that need clamping on tools or on fixtures when the clamp is in the released

position and lastly, there is seldom facility for rapid assembly on tools for the clamps or for their removal therefrom if required for use elsewhere.

It is an object of the present invention to provide an improved differential-link toggle-operated clamp in which the fulcrum of the clamping bar is disposed between the clamping head and the toggle linkage and to ease usage of the clamp.

According to the present invention there is provided

a toggle clamp comprising support means, a clamping member or bar, an operating arm and first and second link elements of a differential toggle mechanism; the first and second link elements being pivotally connected at respective first ends thereof, the second end of the first link element being pivotally connected to one end of the clamping member, so that the effective length of the first link element is shorter than that provided by the second link element; said second

link element, being in tension, is pivotally secured from its second end to the support means, in juxtaposition with the first link element during clamping, the clamping member, in use being pivotable about a fulcrum element intermediate said one end of the clamping member and the effective clamping end thereof; and

the operating arm being connected to said shorter link element so that, in use, the operating arm may be operated to effect pivotal movement of the clamping member about said fulcrum element.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which, on a horizontally positioned tool or work surface:-

Figure 1 is a side elevation of a manually operated horizontal clamp assembly shown partly unclamped;

Figure 2 is a side elevation of a clamp assembly in a closed position; and

Figure 3 is a scrap view on the arrow of Figure 1 showing typical base fixing slots.

Referring to the Figures the clamp assembly comprises a clamp body 1 in the form of an inverted T-section. The clamp body 1 supports a toggle linkage which comprises a pair of parallel links 2 on each side of the web of the clamp body; the links 2 being connected and attached to the clamp body 1 by a pivot pin 3. The free ends of the links 2 are connected to respective shorter links 4 by a common pivot pin 5 extending through all four links. The links 4 each have a generally coplanar handle portion 6 extending at right angles to the ends of the links 4 remote from their pivoted connection with the links 2. Each of the handle portions 6 is formed integrally with its associated link 4 to form a bell-cranked handle therewith. The two handle portions 6 are joined together at their free ends to provide a single handle for operating the toggle mechanism, and hence the clamp.

Each of the links 4 at their ends adjacent to a bifurcated clamp bar 8 is pivotally connected by respective pivot pin 7 to the end of one arm of the clamp bar 8.

The bifurcated arms of the clamp bar 8 are curved towards one another and are connected at their ends 9 to form the operative head of the clamping mechanism. Intermediate the respective ends 9 of the arms of the clamping bar and their pivotal connections to the links 4 is a fulcrum pin 10 which is fixed to and extends between the two arms of the clamping bar 8.

The frontward facing surface of the clamp body 1 includes a slot 11 extending horizontally across, and opening out towards the frontward facing surface of the clamp body 1. The lower surface inside the slot extends upwardly from the front surface of the clamp body and at its inner end is shaped to snuggly receive the fulcrum pin 10. The depth of the slot 11 and the position of the fulcrum pin 10

on the clamp bar 8 are such that when the links 4 and 2 are disposed vertically overlapping one another, as in Figure 2, the clamping bar is disposed horizontally and the fulcrum pin 10 is received at the base of the slot 11. An angled screw 12 is received in a corresponding tapped hole 13 in the rearward facing surface of the clamp body 1. This screw projects from the rearward facing surface of the body 1 to provide an abutment surface for the pivot pin 5. The screw 12 may be adjusted to ensure a correct amount of 'over-run' on linkage as shown in Figure 2; the use of a lock-nut (not shown) to maintain adjustment is optional.

Referring now to Figures 2 and 3 the clamp is secured to tools or fixtures by means of forward facing slots 14 in the base portion of the clamp body 1. These slots may be made in the form of key hole slots if desired. The forward facing part of the base of the clamp body 1 adjacent the slots is chamfered, as at 15, to

facilitate the sliding of the clamp base under bolt head/s. Such an arrangement is advantageous as the bolt heads are located near the front end of the clamp base and therefore do not present any obstruction to the movement of the toggle linkage or handle. A positioning pin or dowel (not shown) is located in a hole 16 in the base of the clamp body to provide means for accurately realigning the clamp if for any reason it is required to move the clamp.

The operation of the clamp will now be described. Referring to Figure 1 the clamp is shown in a partially released position in which the clamp bar 8 is being moved upwardly away from its horizontal clamping position. This movement is produced by pushing the handle 6 upwardly in an arc so that the pivot pin 5 is forced rearwardly and allowing the pivot pin 7 to move nearer towards the base of the slot 11 so that the fulcrum pin 10 can slide downwardly out of the slot 11. When th handle has been moved forwardly sufficiently the

fulcrum pin 10 slides completely out of the slot enabling the clamp head to be moved upwardly over the top of the clamp body and the handle portion to be pivoted about the pivot pin 5 so that both the clamp bar and the handle can be shifted to the rear of the clamp body leaving space for a work piece to be inserted or removed as required.

The starting point for the clamping operation of the clamp may again be taken as that shown in Figure 1. The handle portion 6 is now moved downwardly in an arc by an operator with the result that the pivot pin 5 is moved inwardly and the pivot pin 7 is moved upwardly applying an upward force at the rear ends of the clamping bar 8 resulting from the differential-link toggle mechanism at rear ends of said bar, making available a similar downward force at the clamping head 9 of said bar which will now have attained the horizontal clamped position shown in Figure 2, with little or no force having been wasted on the intermediately positioned fulcrum pin 10.

Additionally the shape and/or proportions of clamp body 1 and clamp bar 8 can be varied to suit component requirements without increasing overall height of clamp unduly while clamp body 1 can have forms other than the T-section of drawings with its sloping ends by using angles/channels of rolled, bent plate, cast or forged shape and the like or even be limited to a flat plate fixed in situ on tools.

The fulcrum slot 11 can revert to a hole if facility for rearward lifting of clamp bar 8 is not required and in fact would necessarily have to be a hole if a pneumatic or hydraulic actuator is used instead of a clamp arm manually operated, said actuator would act upon the short links 4 of toggle or upon an extension thereof in line with pivot pins 5 and 7 centre line or at any angle thereto.

In the particular case of using a single first link element 4 with a bifurcated clamp bar 8 one utilises 'joggled' second link elements 2 to clear said clamp bar 8 but spacer elements between links 2 and 4 or use of a shouldered pivot pin 5

will equally provide the needed clearance.

When support member lacks a central web the fulcrum slot 11 is transferred to the lateral walls of support member 1, the longer link elements 2 of toggle are placed outside clamp arm 6 and the toggle linkage and are secured to lateral walls of said member by pivot pins 3 leaving toggle action essentially unchanged.

CLAIMS.

1. A toggle clamp comprising support means or clamp body, clamping member, operating arm, first and second link elements of a differential toggle linkage, the first and second link elements being pivotally connected at respective first ends thereof, the second end of the first link element being pivotally secured to one end of said clamping member, using cantilevered pivot pin or pin supported in hinged assembly of said first link element and clamping member, keeping effective length of first link element shorter than that of second link element, said second and longer link element being pivotally secured

from its second end to the support means, in juxtaposition with the first link element when clamping, the clamping member being pivotable about a fulcrum element intermediate said one end of the clamping member and its effective clamping end, said fulcrum element, firmly secured to said clamping member, being slidably located in mating slot/s provided in the support means to facilitate entry or release therefrom, and having said operating arm rigidly connected to said first link element of toggle to enable pivotal movement of said clamping member about said fulcrum element and transmit full toggle force for clamping.

2. A toggle clamp as claimed in claim 1 wherein the operating arm extends away from the support means in its clamped position, to form a bell-crank lever with said first link.

3. A toggle clamp as claimed in claim 1 wherein the support means is a channel section, the clamping member and toggle linkage being

pivotally disposed within said channel section, supporting slots being provided for the fulcrum element in walls of said section.

4. A toggle clamp as claimed in claim 1 or claim 2 having at least one of said first link elements and two of said second link elements the said two links being pivotally disposed on each side of the central axis of the support means, and being 'joggled' or otherwise spaced outwardly to clear clamp bars in use.

5. A toggle clamp as claimed in claim 1 where the support means is a T-section, of solid or built-up type, carrying pairs of both said first and second link elements, the longer links of each pair being pivotally disposed on sides of said support means and being pivotally connected to the shorter links for toggle actuation.

6. A toggle clamp as claimed in claim 3 or claim 5 wherein the clamping member comprises a

twin or bifurcated bar along part or all of its length, the fulcrum element being supported in side walls of channel section or in centre web of T-section of support means as applicable.

7. A toggle clamp as claimed in claim 1 or claim 6 wherein the fulcrum element is secured to and spans the bifurcation on clamp bar or if not bifurcated, traverses said bar leaving ends of fulcrum element proud for use as pivots.

8. A toggle clamp as claimed in claim 3 or claim 5 wherein each of the lateral walls, or the centre web, of the support means carries a slot opening towards a surface of the support means that faces operative end of clamp and sloping towards base of said support means from its inner end to its opening, said slot being shaped to slidably receive and to retain fulcrum element when clamped, or to allow clamping member to be lifted clear, if unclamped.

9. A toggle clamp as claimed in claim 8 wherein the support means carries a hole or holes instead of a slot or slots, to pivotally support the fulcrum element, particularly but not exclusively, when clamp is power-actuated.

10. A toggle clamp as claimed in any of the preceding claims wherein the support means, unless welded on to tools, has a base plate with at least one open or key-hole slot positioned therein near edge of base facing clamping end of clamp to fix clamp on tools and having a separate hole, remote from said slot, for a pin to align base correctly.

11. A toggle clamp having a juxtaposed-links differential toggle linkage to actuate near end of adjacent clamping bar, said bar having a fulcrum element intermediate said linkage and the remote clamping end of said bar with, on manually operated clamps, the optional use of quick release/retention slots for fulcrum element and clamp bar, plus slot/s in clamp base for rapid set-up/removal of clamp.

12. A toggle clamp substantially as herein-before described with reference to, and as illustrated in, the accompanying drawings.

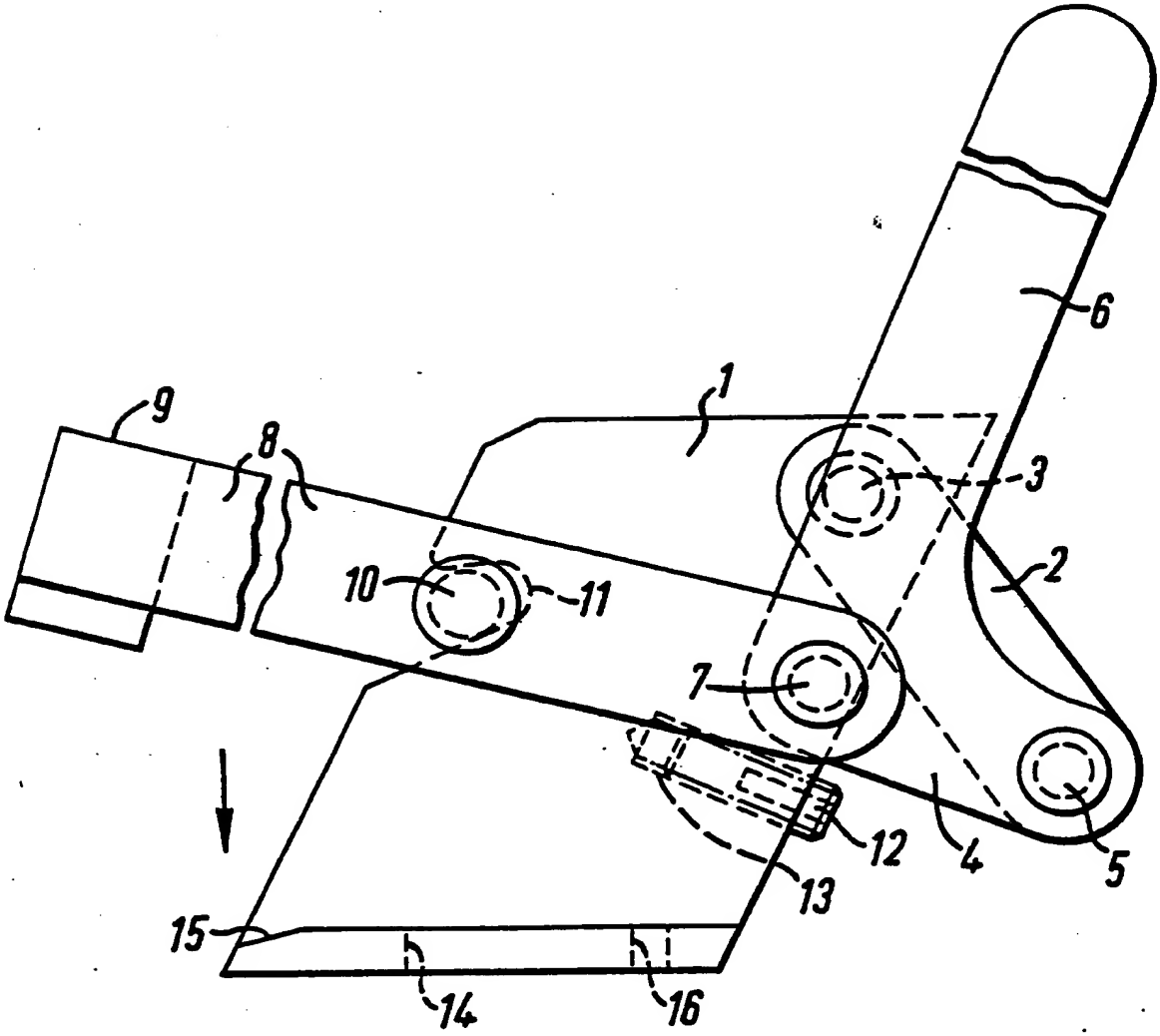



FIG.1

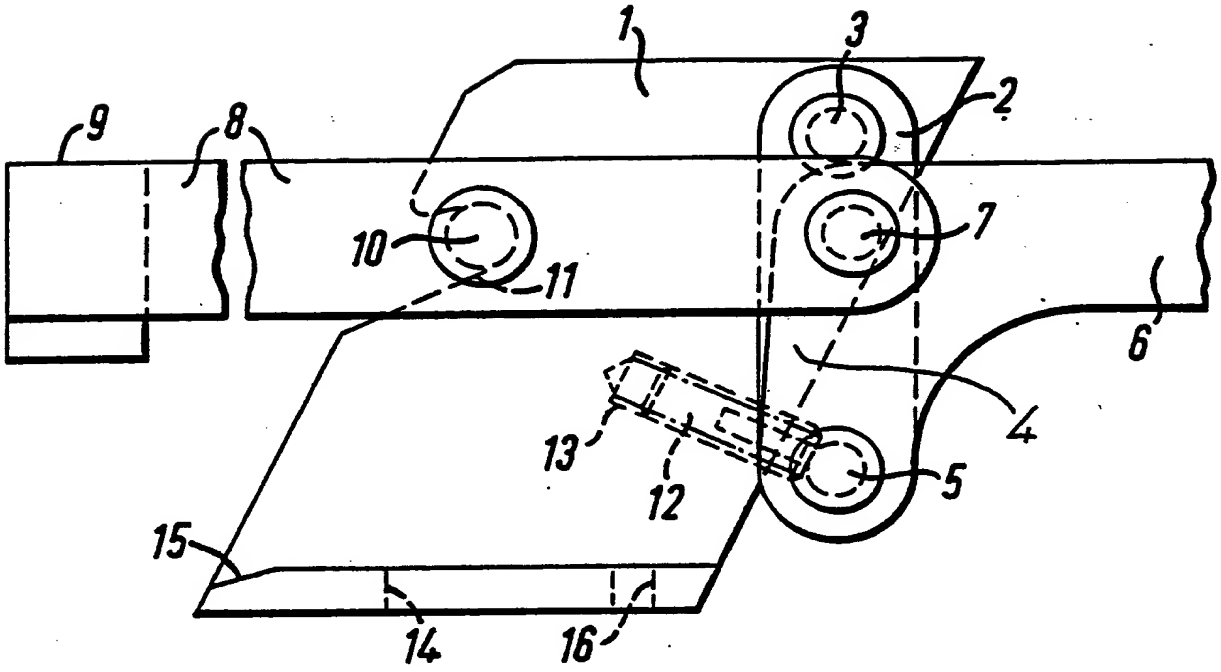



FIG. 2

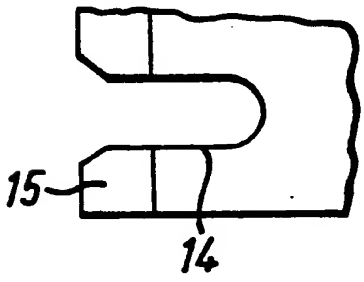



FIG. 3

# INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 79/00082

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

B 25 B 5/12; F 16 B 2/18

## II. FIELDS SEARCHED

**Minimum Documentation Searched [4]**

| Classification System | Classification Symbols |
|---|---|
| Int.Cl.[2] | F 16 B 2/00; B 25 B 5/00; B 23 Q 3/00 |

**Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]**

## III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

| Category [15] | Citation of Document, [16] with indication, where appropriate, of the relevant passages [17] | Relevant to Claim No. [18] |
|---|---|---|
| X | GB, A, 932218, published July 24, 1963, see page 2, lines 55–129; page 3, lines 1–6, figures 1 and 2, Speed Tools | 1,2,3,4,6,7, 8,11,12 |
| | GB, A, 821132, published September 30, 1959, see page 2, lines 8–123; figures 5 and 6, Cochrane | 1,2,3,4,6,7, 8,11,12 |
| | US, A, 2350034, published May 30, 1944, see page 1, page 2, lefthand column, lines 1–32, Herrington | 1,2,4,5,6,9, 11,12 |
| | GB, A, 1452624, published October 13, 1976, see page 2, lines 46–93, DE-STA-CO Metallerzeugnisse | 1,2,9 |
| | GB, A, 581670, published October 21, 1946, see page 2, lines 99–113; page 3, lines 1–36, Jenkins | 1,2,3 |

* Special categories of cited documents: [18]

"A" document defining the general state of the art

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

## IV. CERTIFICATION

| Date of the Actual Completion of the International Search [3] | Date of Mailing of this International Search Report [3] |
|---|---|
| 10th August 1979 | 22nd August 1979 |
| **International Searching Authority [1]** | **Signature of Authorized Officer [20]** |
| European Patent Office | G.L.M. Kruydenberg |

Form PCT/ISA/210 (second sheet) (October 1977)